Peer-Review of: "Characterising terrestrial influences on Antarctic air masses using radon-222 measurements at King George Island", by Chambers et al.

Principal Criteria	Excellent (1)	Good (2)	Fair (3)	Poor (4)
Scientific Significance: Does the manuscript represent a substantial contribution to scientific progress within the scope of Atmospheric Chemistry and Physics (substantial new concepts, ideas, methods, or data)?	X			
Scientific Quality: Are the scientific approach and applied methods valid? Are the results discussed in an appropriate and balanced way (consideration of related work, including appropriate references)?		X		
Presentation Quality: Are the scientific results and conclusions presented in a clear, concise, and well-structured way (number and quality of figures/tables, appropriate use of English language)?		X		

General comments: The paper is a very valuable contribution towards the whole data archive of global radon measurements, especially for the Antarctic region, where high quality radon data are scarce. Furthermore, it provides a better understanding of air mass transport with radon as a tracer (including polar subsidence) and dilution factors affecting anthropogenic pollution events. The latter calculations, especially, constitute a nifty way of better understanding air mass transport and how radon dilution (theoretical calculations backed by measurements) can be verified by lateral dispersion and venting as well as frontal air movements. It is also interesting to note, that in contrast to radon levels in other global regions, the Antarctic radon data is characterized by very low levels (< 100 mBq/m3) where relatively small variations constitute important changes at these low concentration levels.

The paper is concise and well-structured and the scientific techniques clearly specified as set out under Methods (section 2). The manuscript aptly addresses the relevant scientific questions within the scope of ACP. Its content also portrays very effectively the general scope of the topic (title). The use of the English language is on the whole very commendable and precise. Furthermore, the figures are very pertinent and easy to read and the reference material very comprehensive and appropriately cited.

For the above reasons, the paper should be published. No major alterations are required.

Summary feedback on the following aspects:

1. Does the paper address relevant scientific questions within the scope of ACP?

   Yes

2. Does the paper present novel concepts, ideas, tools, or data?

   To some extent, yes

3. Are substantial conclusions reached?

   Yes

4. Are the scientific methods and assumptions valid and clearly outlined?

   Yes

5. Are the results sufficient to support the interpretations and conclusions?

   Yes

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

   Yes

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

   Yes

8. Does the title clearly reflect the contents of the paper?

   Yes

9. Does the abstract provide a concise and complete summary?

   Yes

10. Is the overall presentation well-structured and clear?

    Yes

11. Is the language fluent and precise?

    Yes. Some minor changes to language style can be made

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

    Yes

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

    No

14. Are the number and quality of references appropriate?

    Yes

15. Is the amount and quality of supplementary material appropriate?

    Yes

Specific comments:

1. **Question of radon uncertainty:**
   When dealing with such low radon concentrations (< 100 mBq/m3) and making inter comparisons (e.g. between KSG and Dumont d'Urville; p. 11557) the question arises how reliable a few tens of mBq/m3 are between data sets? On p. 11552 (line 25) the radon concentrations between KSG (76.5 mBq/m3) and Mawson Station (63.7 mBq/m3) are compared. However, the standard deviation for KSG is 100 mBq/m3 compared to the 33.4 mBq/m3 for Mawson Station. Is this comparison still meaningful?
   On p. 11557, some radon values even have a figure behind the decimal point, e.g. line 2 (34.7 mBq/m3), while others, e.g. line 5 (74 mBq/m3) does not. There should be consistency here.
   It is suggested that under section 2.2 (Radon measurements) the issue of radon uncertainty is defined more succinctly.

2. **Atmospheric lifetimes:**
   P 11545 (line 26) to P 11546 (line 2): Since radon's oceanic…….distant terrestrial pollution: The half-life of radon (3.82 days) is << than the atmospheric residence time of many trace gases such as CO, CH4 and CO2. Perhaps the authors can be more specific in what is meant by: "….and its (radon) atmospheric lifetime is comparable to that of many anthropogenic emissions…"

3. **Population centres and radon**
   P 11550 (line 21 to 24): "In terms of potential anthropogenic pollutant sources…" This sentence can easily be misunderstood that highly populated regions could also be a source for elevated radon levels. The sentence in lines 23 and 24 might be changed to: "Based on the findings…….considerable inter-annual variability in trace gas emissions (e.g. CO and CO2) is likely for this fetch region.

4. Use of language:

a. P 11544, line 1: The direct two-filter dual (not due) flow-loop
b. P 11545, line 1: ….and has a relatively undisturbed…….
c. P 11545, line 13: …..lies within this sector……

There are a few cases where the word “the” is missing.

d. Examples:
   P 11545; line 13: “….topography in the order of 600 - 700m……”
   P 11546, line 12: “…..traceable to the National Institute ……..”
   P 11546, line 19: “…..at the commencement of the measurements……..”
e. P 11548, line 16: Re-write sentence: “……radon composite (Fig. 4b) a weak diurnal signal was recognisable…”
f. P 11549, line 22: Is the word “excursion” generally familiar or is “anomaly” perhaps more appropriate?